PREDEC 2016

International Symposium on PREparation for DECommissioning

How Digital Autoradiography technique can be useful for D & D projects?

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Outline

- LASE laboratory: Analytical Support to Facilities Laboratory
- Digital Autoradiography Technique
- Digital Autoradiography for Radionuclides Mapping
- Digital Autoradiography in support of sampling processes
- Conclusions

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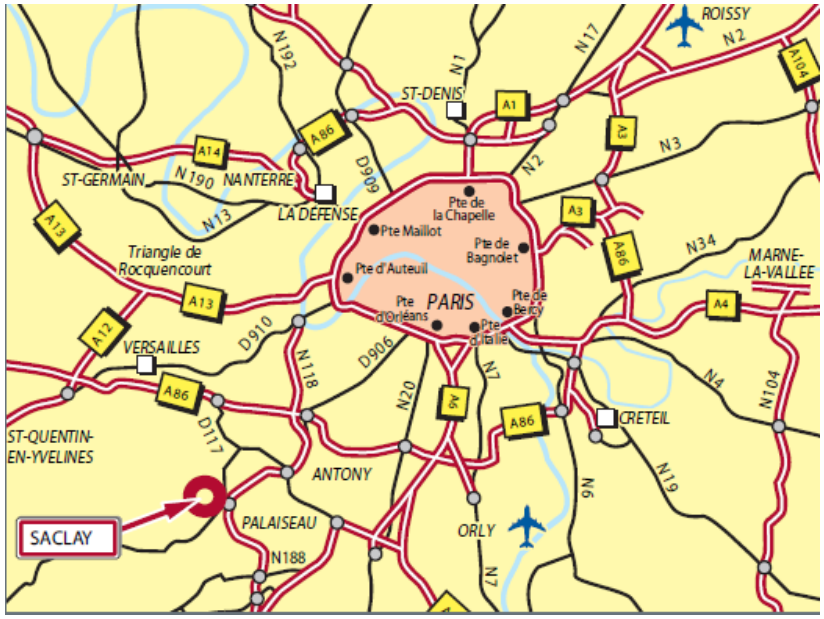
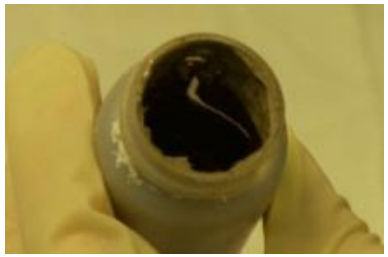
LASE Laboratory

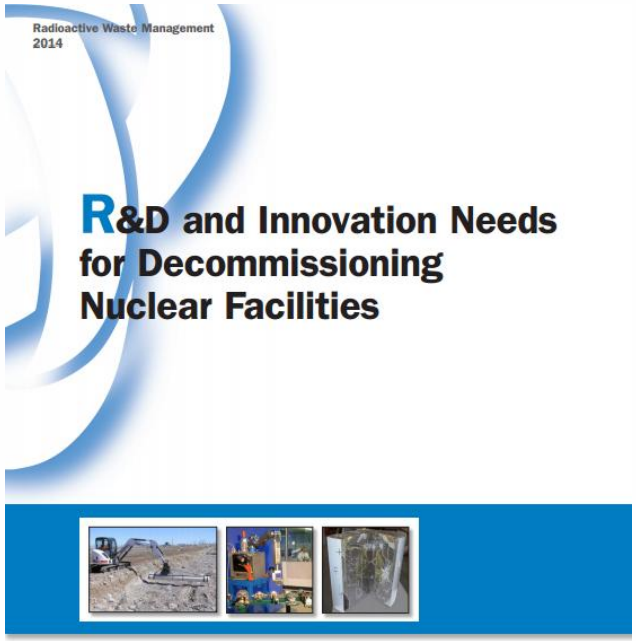


- Different characterization techniques for low and intermediate level wastes.
- Destructive analysis (sample = 1 g)
- Radiochemistry
- Alpha, Gamma, LSC
- Elemental analysis

- In situ technique: Autoradiography



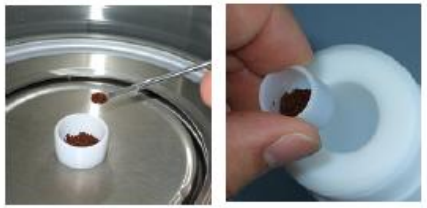
LASE Laboratory



Lots of Radwastes must be characterized

Innovations are required for in situ techniques, for techniques allowing a better sampling process

Destructive techniques need less than 1 g of sample for digestion process



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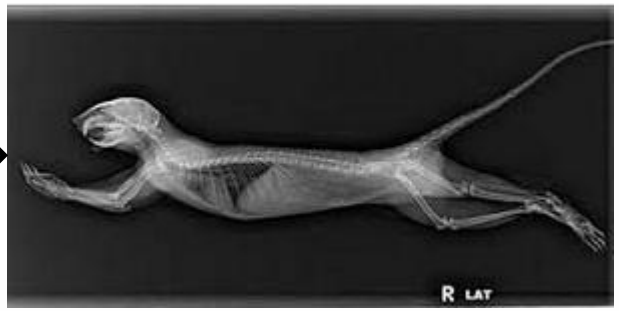
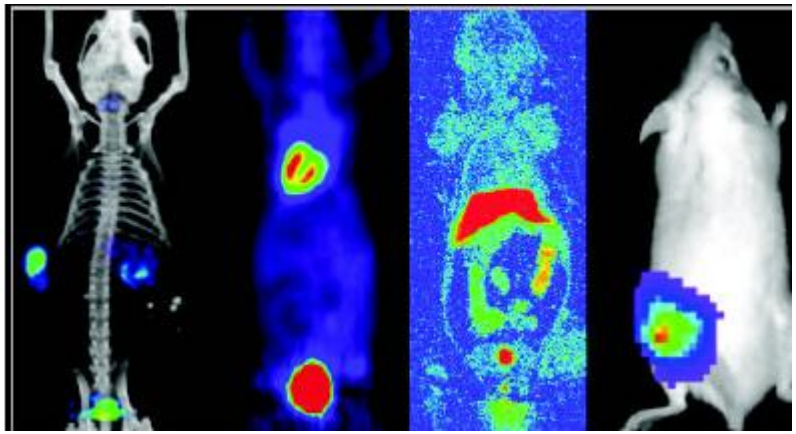
Radiography

Source →  → Detector

Autoradiography

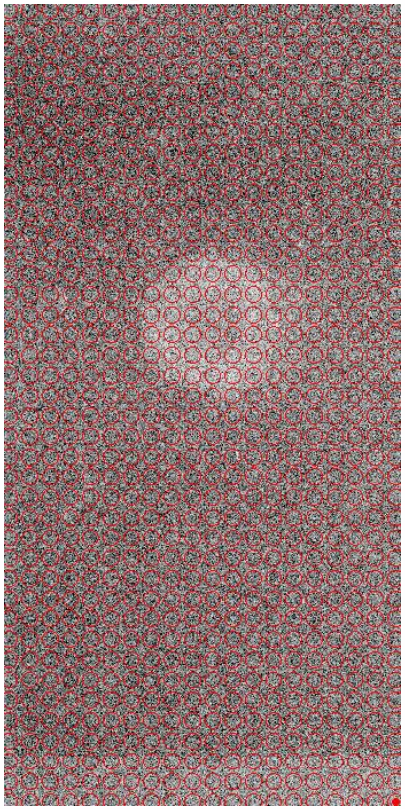
 → Detector

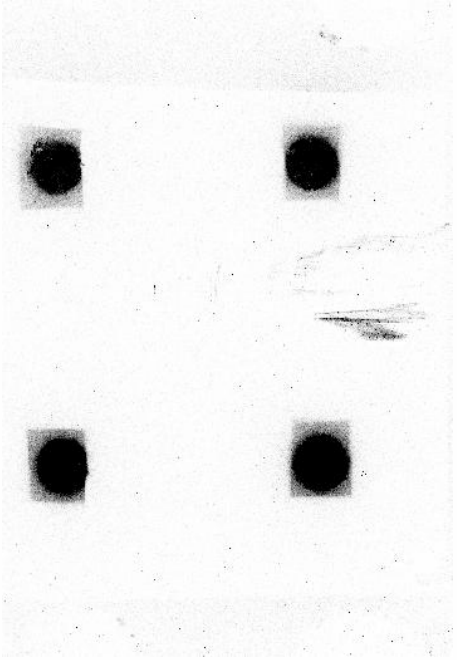
Interests: H, C, S, … radionuclides difficult to measure

DA Technique

Sensitive side

Plastic side



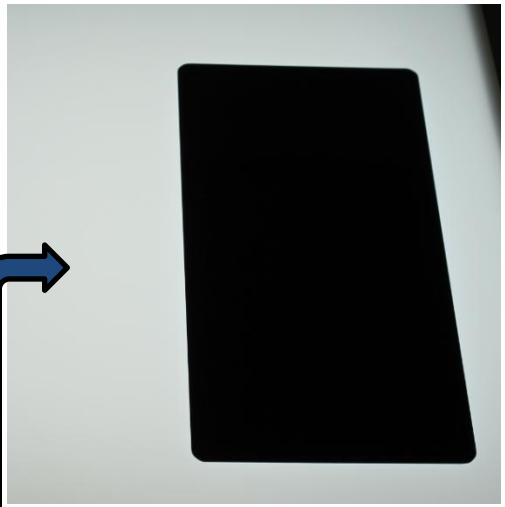


« Image » of radioactivity

DA Technique

Screens can be reused hundreds of time

(1) Screen initialization

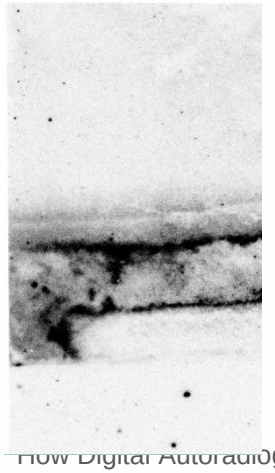


(2) Screen Deposit

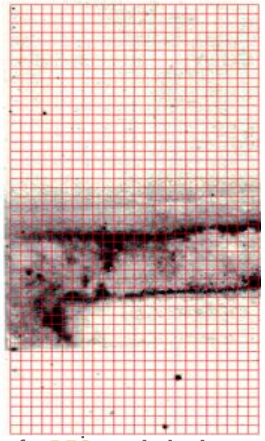
(3) Exposure Time

(4) Screen withdrawn

(5) Screen scan



(6) Calculations



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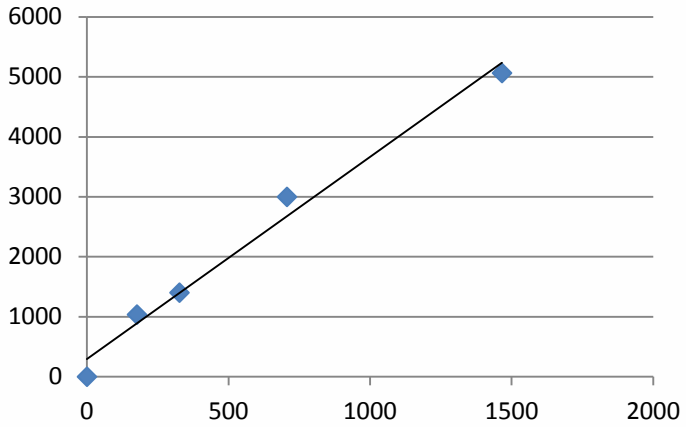
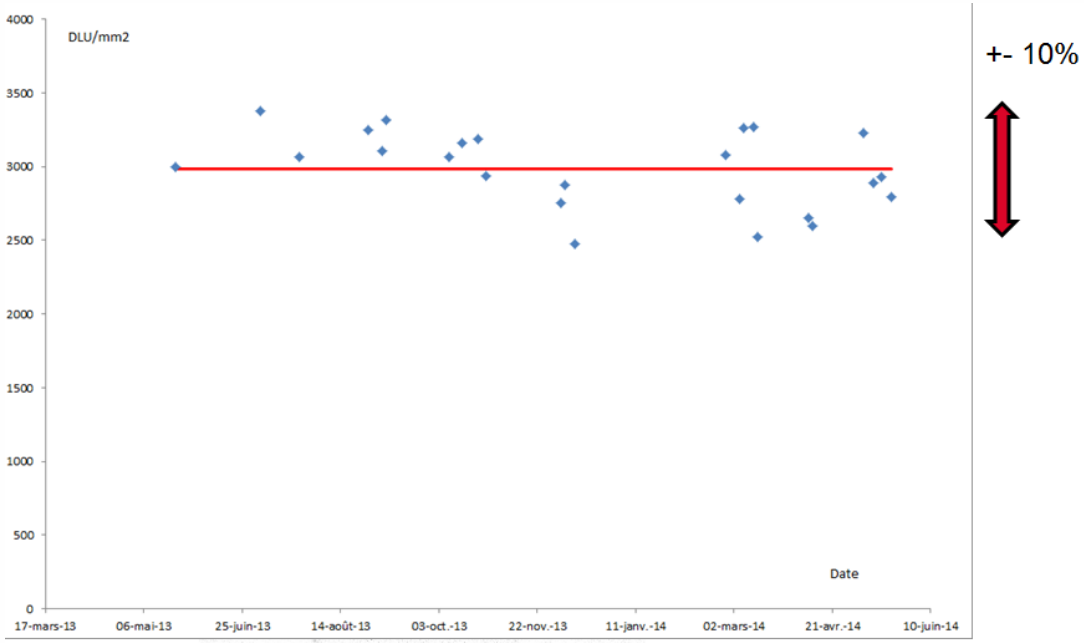
DA Technique

- Semi quantitative values are achievable.



- Repeatability corresponds only to few percents

Same H-3 analysis



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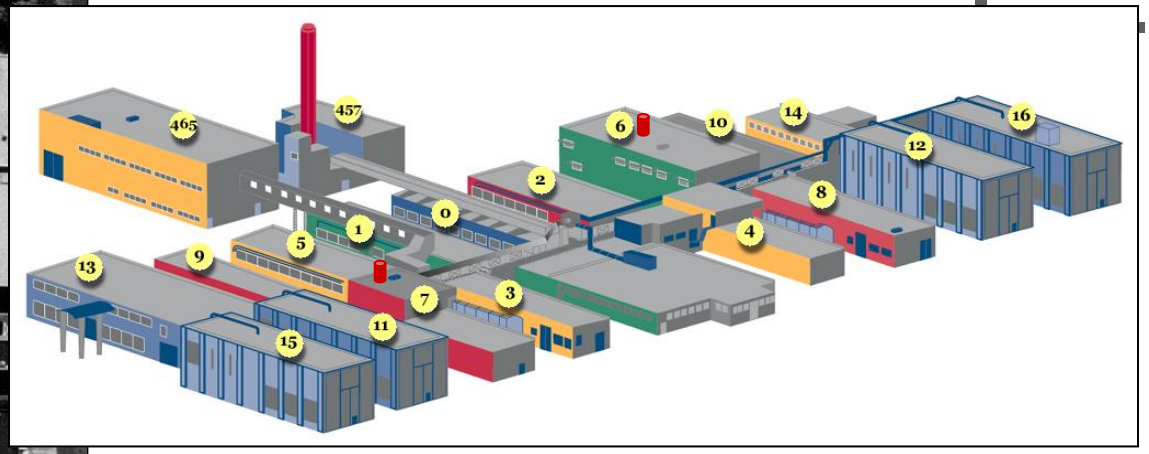
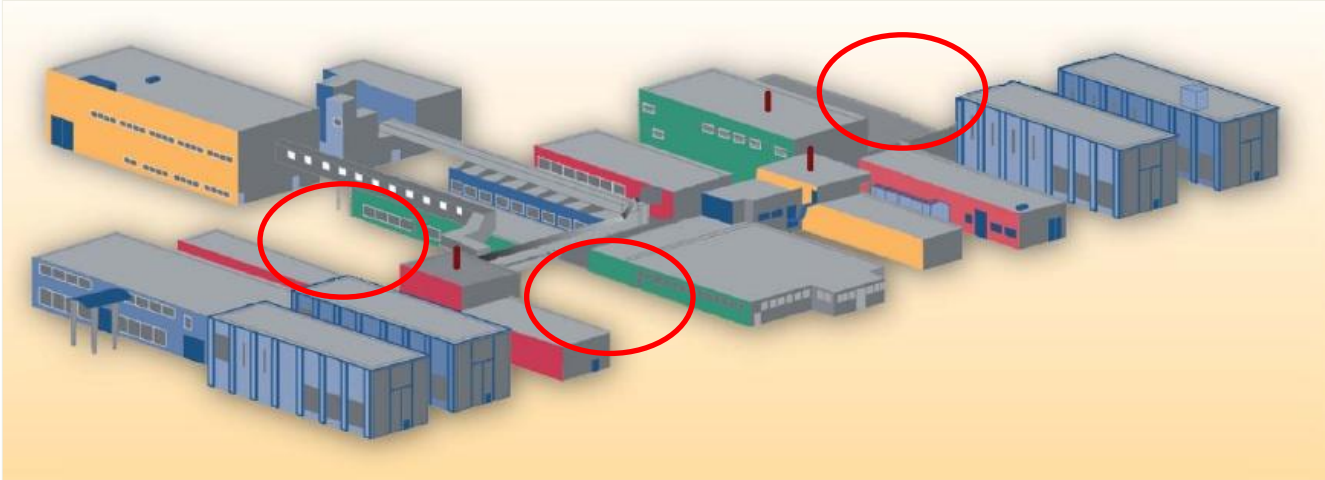
Radionuclides mapping

High radioactivity Laboratories in Facility 459 CEA, Saclay



H-3 mapping requirement

3 laboratories (250 m^2 each) must be destroyed. After historical study characterization is required.



Radionuclides mapping

1) Shutdown after the period of research

2) Cleanup

3) Researches on the history of the facility

4) R&D required for initial state characterizations.

5) Dismantling

Radionuclides mapping

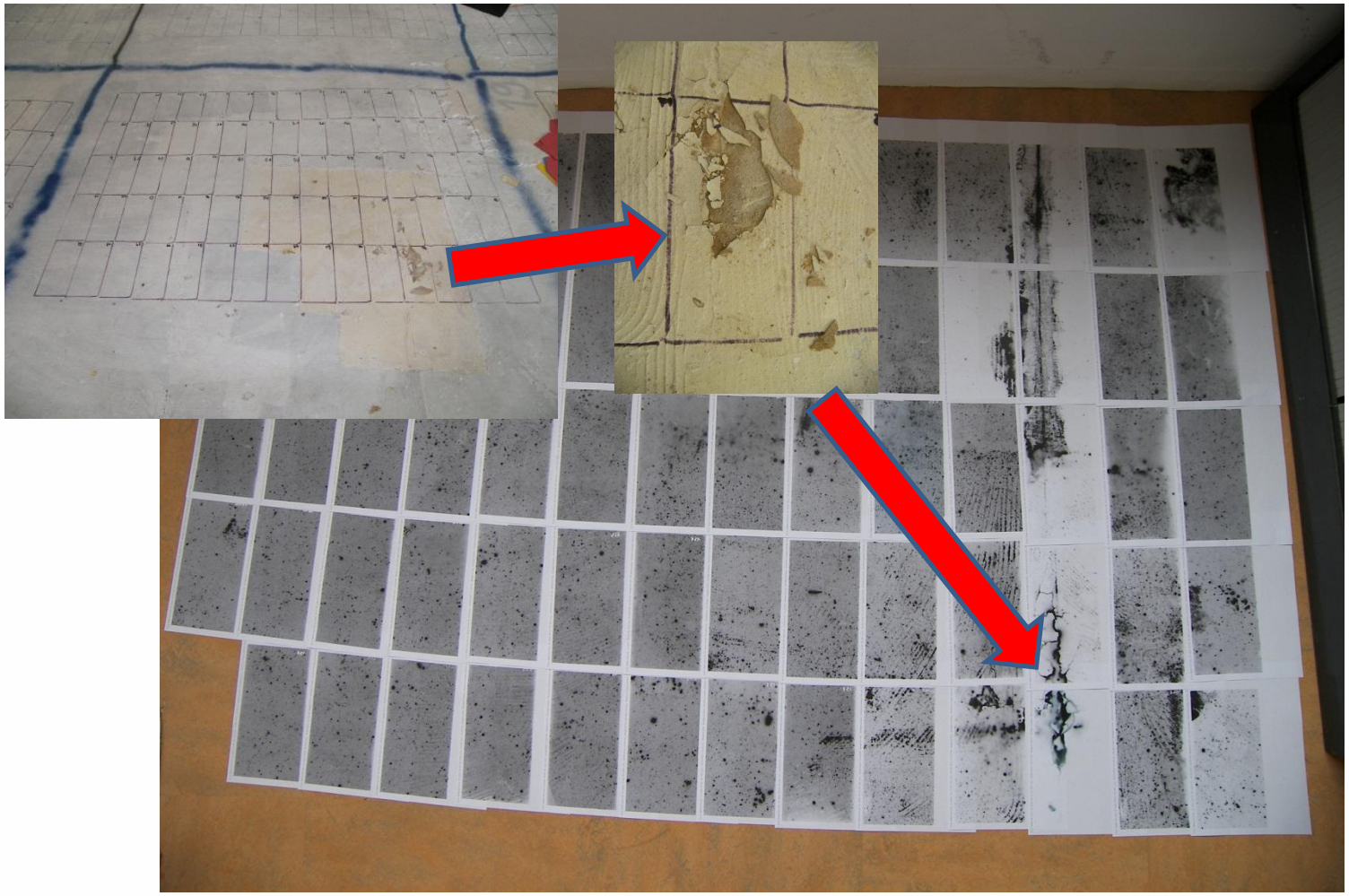
Floor

Ceiling

Wall

Radionuclides mapping

A grid corresponding to 70 screens

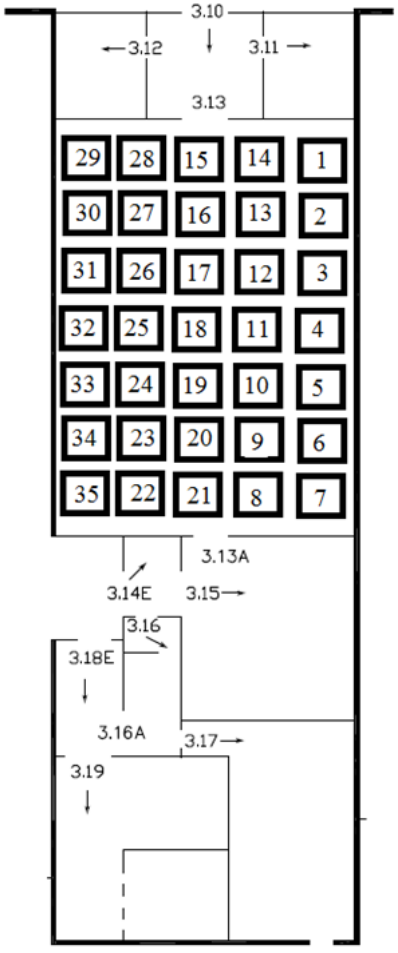


Radioactivity image, here C-14

Radionuclides mapping

100 % measurements is very difficult and not efficient when considering geostatistical approach

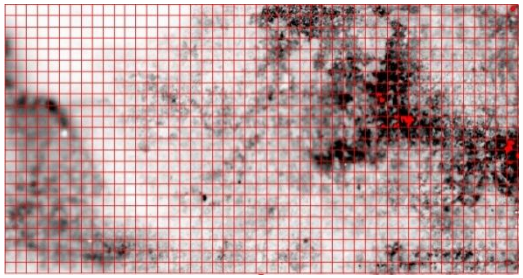
35 zones were drawn on concrete surface

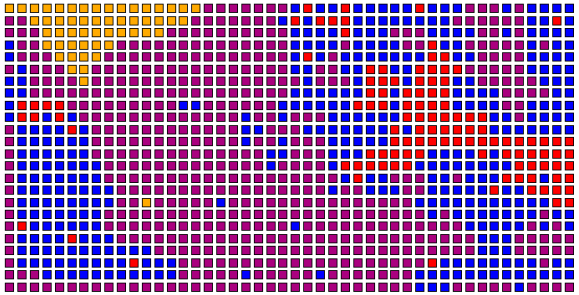


1000 screens were deposited on the floor and located precisely by using a telemeter.

Radionuclides mapping

All Autoradiography images are processed by a homemade software

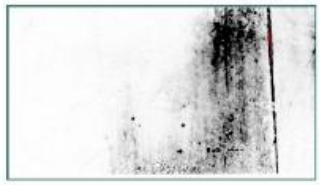




Here image resolution corresponds to small square of 5 mm * 5 mm

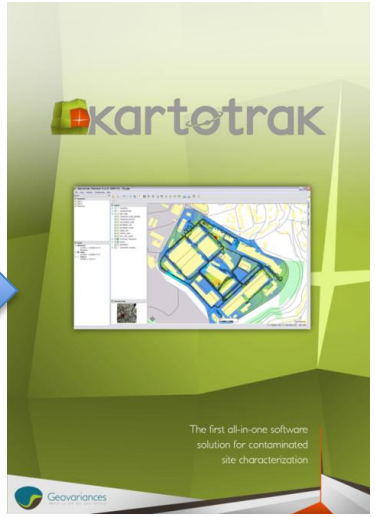
ISA

Logiciel d'Interprétation et de Suivi de l'Autoradiographie

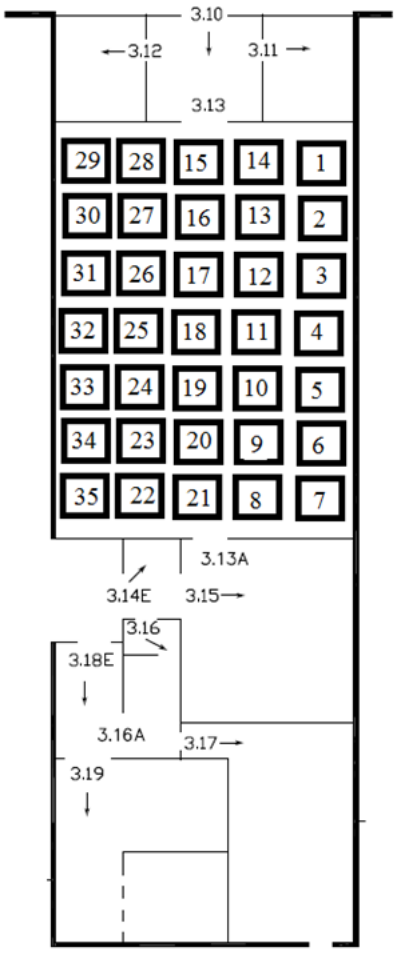


X1, Y1, DLU1
X2, Y2, DLU2
X3, Y3, DLU3

……

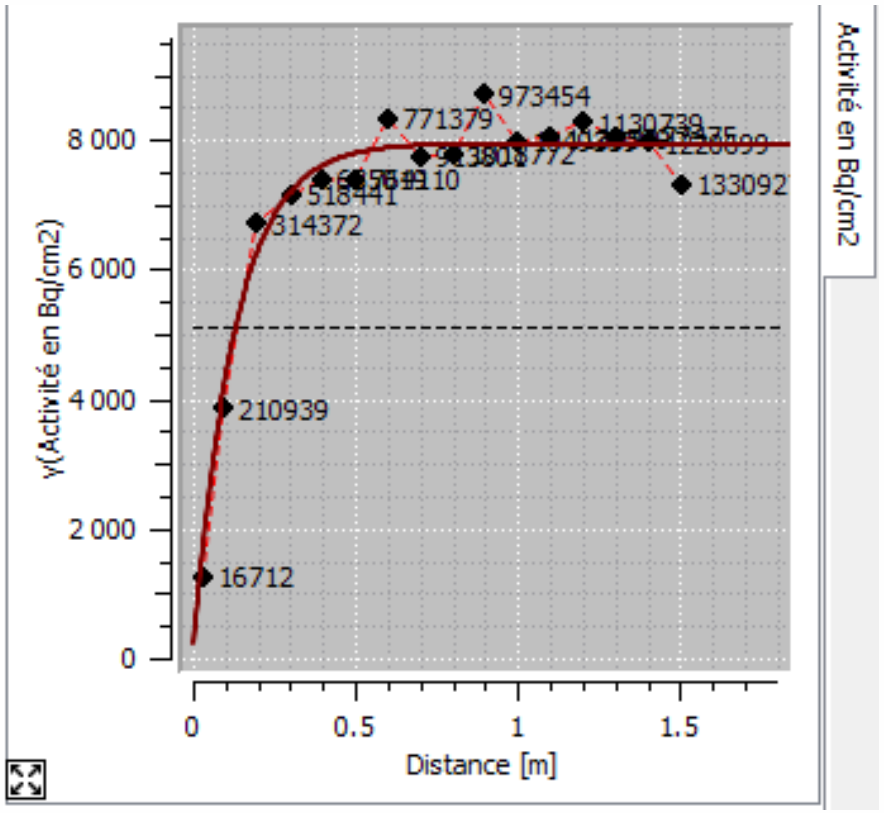


Radionuclides mapping



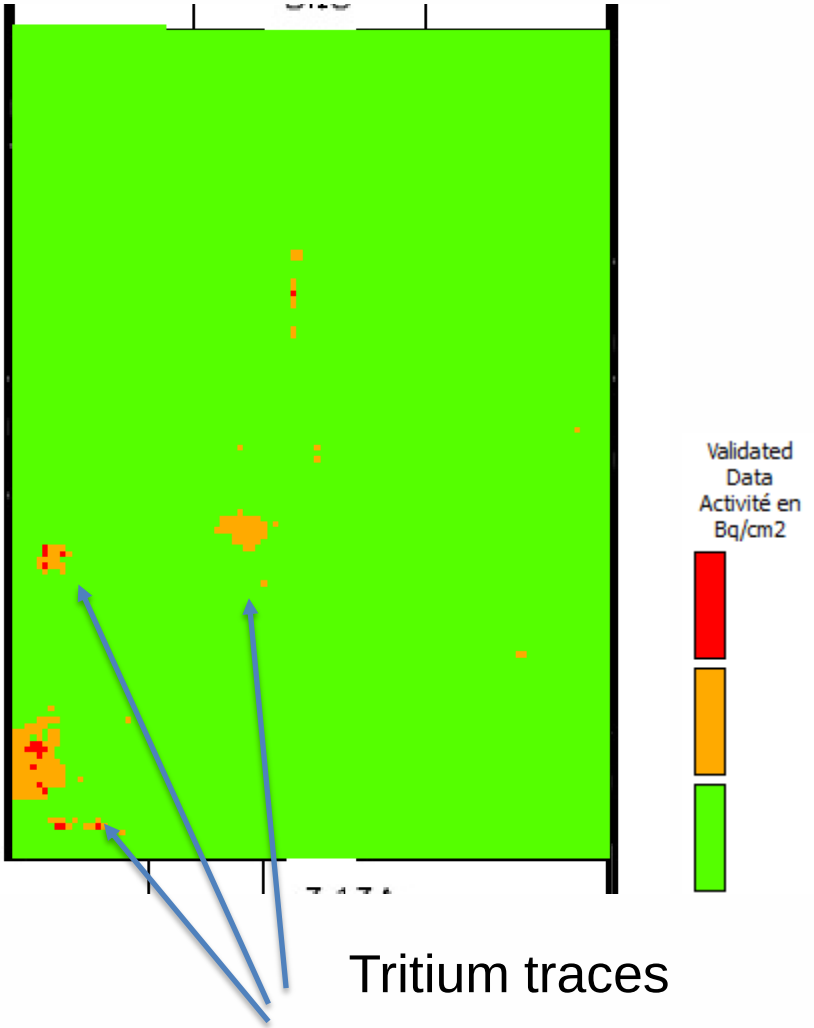
For the characterization: approximately 20 000 values processed

Variogram calculated



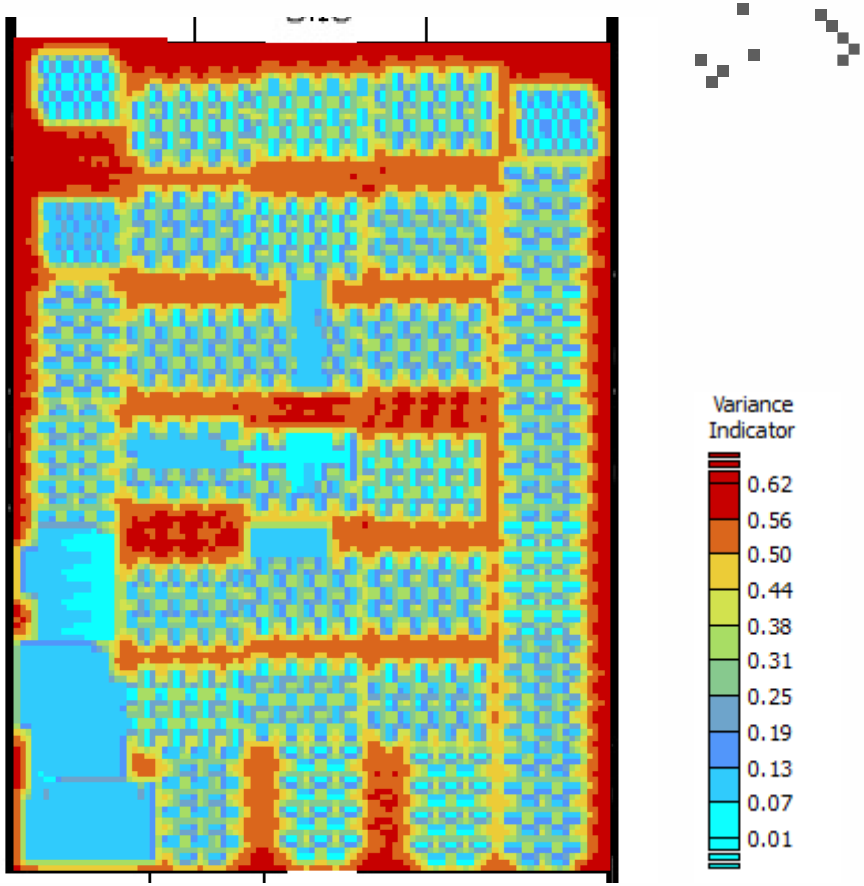
Radionuclides mapping

Kriging calculation



Tritium traces

Uncertainties



Only 20% investigated by autoradiography

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Sampling process

Classical sampling process
by wipe tests = problems for non labile radioactivity

Alpha spectrometers
Liquid Scintillation Counting

In Situ Samplings

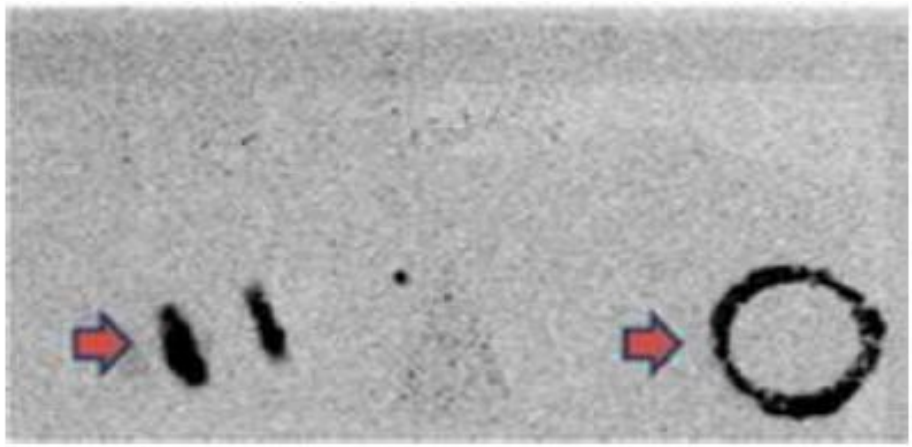
Laboratory measurements

In situ measurements by Autoradiography

Sampling process

Sampling process for tritiated wastes

Destructive measurement of H-3 is done by pyrolysis followed by Liquid Scintillation Counting (LSC)

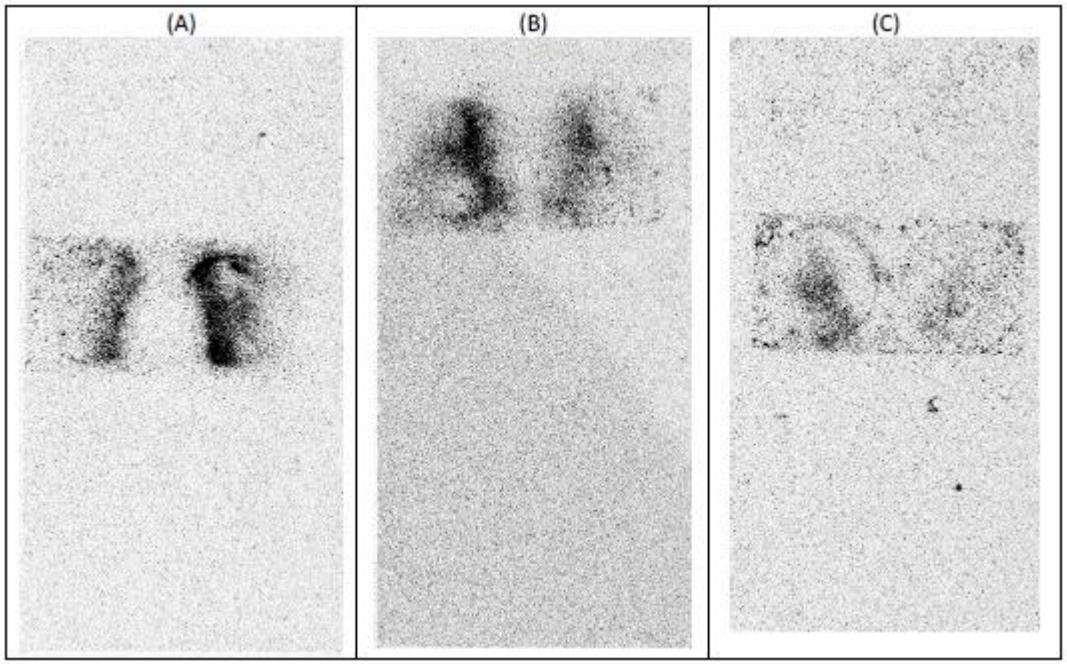


Sample = 1 g

Sampling process

Rapid investigation of wipes containing Uranium traces

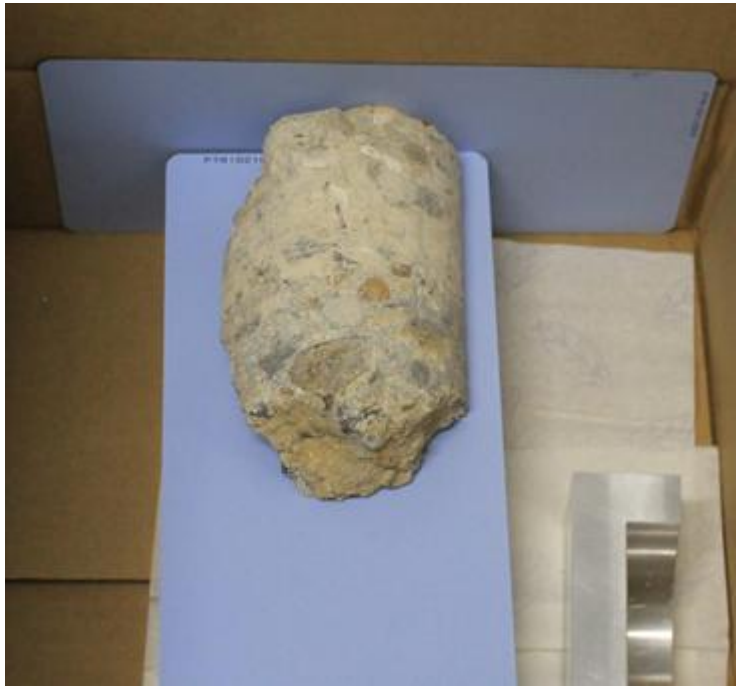
Only 3 wipes among 7 contained Uranium.

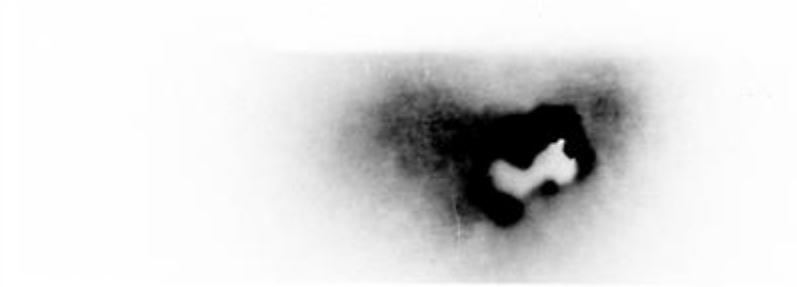


After studies with a destructive method: wipe digestion followed by alpha spectrometry and/or ICP-MS, detection limit was determined at **0.2 Bq/wipe** for Uranium.

Sampling process

Core made of concrete containing C-14





Activity on surface

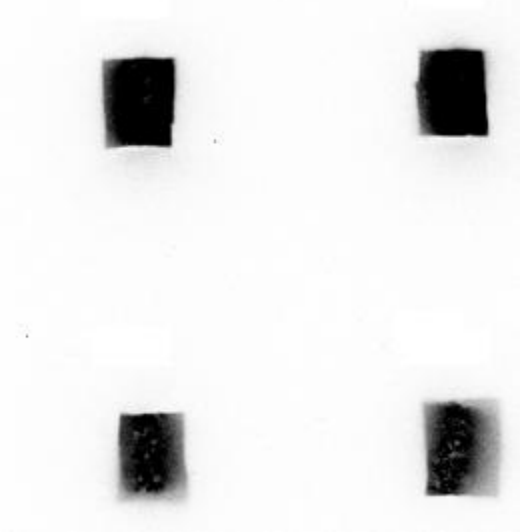
Activity in depth

Interesting sampling

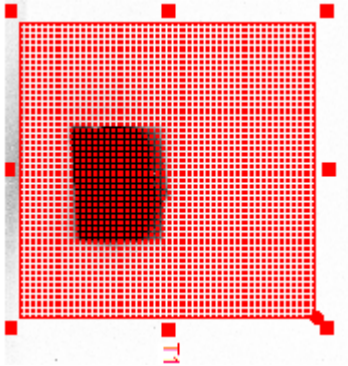
Sampling process

Graphite cores containing C-14

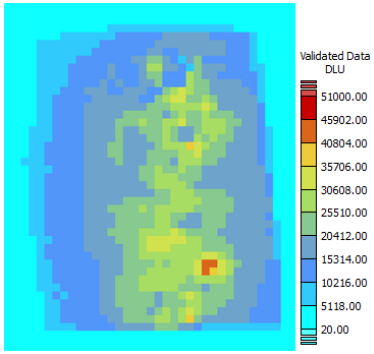
4 small cores on the same screen



Calculations



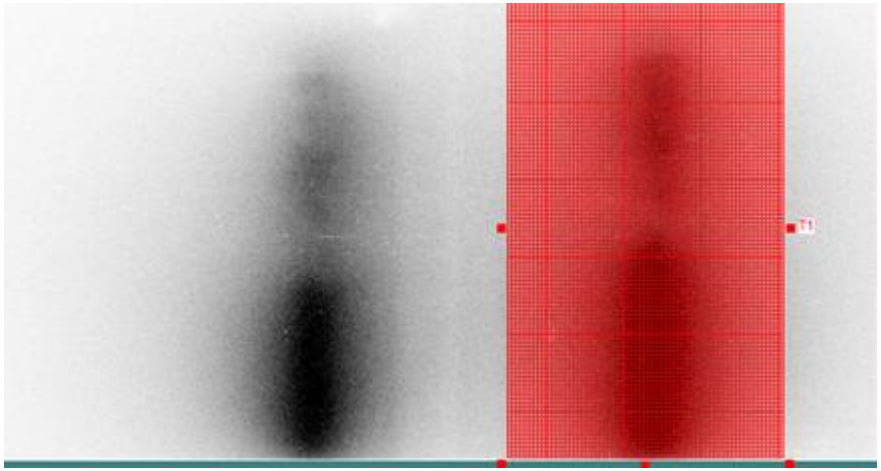
Homogeneity of the contamination at a very low scale

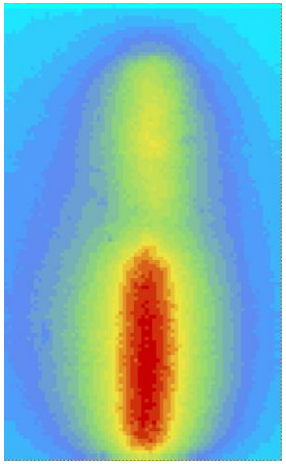


Sampling process

Study of a resin located inside a plastic tube containing I-129

Plastic deposited on a film for 15 minutes





Efficient solution for sampling process

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Conclusions

- Autoradiography technique has been used for characterization of Radwastes.
- The technique is efficient for radionuclides difficult to measure : alpha and beta emitters
- Autoradiography is very sensitive to alpha > beta > gamma
- It allows characterizations to provide radionuclides mapping and better sampling process.
- Semi quantitative values can be obtained.

- Researches are going on to improve the Autoradiography technique:

« Preliminary identification of α and β contaminations through Digital Autoradiography » R Haudebourg, P Fichet

Conclusions

THANK YOU
for your
ATTENTION!